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HOUSING, FLOODING, AND RISK-ECOLOGY: THAMES ESTUARY SOUTH-SHORELAND AND NORTH KENT

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A review, with table, of statements of housing need and historical incidence of sea flooding in the Thames Estuary south-shoreland and north Kent, where past and current programs for flood protection and housing development are explored, show these two activities running in parallel but not yet integrated. Professed sustainability cannot be achieved without an understanding of ecological development with increased evidence of "living with flooding." Land adjacent to the river is currently preferred as offering the most attractive sites at highest land cost, the river being acknowledged as a landscape feature but not as a potential hazard. The thousands of new and existing dwellings that are, or will be, vulnerable to flooding, due either to overtopping of flood defenses, or their failure or absence, are receiving little attention as a design issue. Elementary and regulatory planning methods appear rigidly focused on outdated issues of visual concern in which height restrictions prevent sensible upward domestic expansion. Ways for people to successfully "house" themselves in hazardous environments, inclusive of foreshores and wetlands, would offer an inclusively responsive and visually observable physical statement of successful development in an ecology of risk.

STATEMENTS OF HOUSING NEED

As a consequence of the report by Kate Barker (2004), the U.K. government has determined the need for the provision of 200,000 new homes in southeast England by the year 2016, in what it has been called the London Thames Gateway. This program of housing development, described by the Office of the Deputy Prime Minister as "creating sustainable communities" (ODPM, 2003:57), will occupy 3,000 hectares of "brownfield" land (ODPM, 2004) — land that has been occupied by previous development and, therefore, is not "greenfield." Of this present total of new homes, 120,000 are to be on land adjacent to the Thames Estuary (ABI, 2004), much of which is either already prone to flooding, or will be if, or when, flood defenses are overwhelmed due to rising seas, a storm surge, or both — an increasing likelihood (Lowe and Gregory, 2005). Ten thousand homes may be built in areas of significant flood risk (ABI, 2005:7). Although land on both the north and south shores of the Estuary, the Thames Estuary "floodplain," is protected to a "high standard," it is potentially and increasingly at risk from a large-scale storm surge (ABI, 2004:7; London Assembly, 2005:7).

Neither house building nor flood risk will end, or even culminate, in 2016 — or any other arbitrary year. New housing will itself aggravate water levels and flood risk unless sustainable drainage systems are also incorporated, desirable for any "sustainable" community but essential in flood risk areas. Without these and other measures, it is as yet unclear how a proposal to build thousands of houses on flood-prone land can be called sustainable.

SUSTAINABILITY AND ECOLOGY

What is meant by the currently fashionable catchword of "sustainability," a word so loosely overused? When "sustainability" appeared in the context of development, as debated by the members of the World Commission for Environment and Development in 1987 (WCED, 1987), social need was at the core of its meaning. Sustainable development was defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (see also Swearingen White and Ellis, 2007). It contained two key concepts: the concept of "needs," especially the needs of the poor, and the idea of limitations imposed by technology and social organization on behalf of the environment in meeting those needs. National economies were to be subservient to these key concepts and to incorporate concern for social equity.

Therefore, the achievement of sustainability must be a multi-sectoral objective. It has to do with not only carbon emissions, travel, mechanical ventilation, and natural light but also all other issues that have appropriately been taken on board under its name, all in concerted and harmonious ways, on behalf of present and future generations. Sustainability is not merely about housing or communities but partially about these in their entire environments — not only built environments as neighborhoods but also as communities in their natural environments. This means that the built environment and the natural environments adjacent to it are in harmony as one single environment representing an ecology of interrelated natural and human-made systems.

Modification and integration of people's needs, in relation to the needs of wider environments, expresses ecology, which is defined as "concern with the relations of organisms to one another and their physical surroundings" (Alexander and Fichter, 1973:4). More directly, the origin of "ecology" is said to be the Greek *oikos*, meaning "house" (*ibid.*). Ecology, as the study of environments and the ways that living things "house" themselves in it, lends itself directly to "human ecology," while at the same time, it renders unnecessary the use of that enlargement. "Ecology," though no longer fashionable, would seem in this case to be a more meaningful word than "sustainability," due to ecology being the science of processes for the achievement of sustainability.

It would be neither a sustainable nor an ecological development that was designed and constructed in such a way, or in such a place, as to become destroyed, damaged, or rendered unusable, by flooding or by any other hazard. The resources expended would serve neither present nor future "needs." That this happens repeatedly and on a global scale is an expression of every generation's failure to understand our environments and to respond responsibly to them. That poverty is a root cause of this failure is added expression of inequitable socioeconomics achieving priorities over basic social needs.

Shelter, a general term for dwellings, homes, and housing of any kind in any place, is an essential social need. Our homes are required to shelter us from wind, rain, snow, and extreme heat and cold. Large volumes of water present an extreme hazard equivalent to hurricane winds or lightning strikes that houses, as we have come to know them, are not expected to withstand without special measures being taken in their design and construction. Houses can be designed and constructed to protect their occupants from flooding in ways other than their attempted separation by physical "flood defenses." If it is necessary to build houses close to water, the level and presence of which is sometimes unpredictable and unreliable, then houses and communities can, and should, be designed to respond to that environmental condition as well. Indeed, it should be made a condition of occupying such sites that houses be designed for that specific additional purpose as a matter of public health and safety.

Such a response, one that acknowledges environmental risk and accommodates it, would be ecological in that it integrated and harmonized housing with flood risk, instead of separating the one from the other. The ensuing "risk ecology" (Kelman and Lewis, 2005) would seem to be more advantageous than attempted separation of one from the other by "flood defenses" that may prove to be unreliable due to poor maintenance, poor design, structural failure, or overtopping. A Kentish Internet source recalls, "In some cases where sea-walls had been constructed to enclose marshland, numbers of people had been induced by them to live behind their apparent protection ... contributing to loss of life in 1953" (Kent County Council, 2004).

In the U.S., investigations that centered upon "why people occupy hazardous floodplains as they do" led, 50 years ago, to the "troublesome finding that the net effect of heavy federal investment in flood-control works such as dams, channel improvements, and levees in the twenty years following the passage of the Federal Flood Control Act of 1936 was to increase the total national losses from floods at the same time that more than five billion dollars was expended on prevention works" (White, *et al.*, 1958; quoted in White, 1974:3). As another researcher concluded, "Modern societies cannot expect to cope effectively with hazards in the environment by relying solely upon technological solutions" (White, 1974:255).

Flood defenses have so often implied a falsely absolute protection, under the assumption of which more developmental land use has taken place, leading to greater destruction, damage, and casualties when flooding eventually, inevitably, occurred.[1] Overt visual expression of risk ecology would be an integral demonstration for both immediate and succeeding occupancies of hazardous places, a demonstration of awareness that could otherwise become eroded or lost over time. It would be a physical expression of collective memory and of living with flooding, instead of living with the pretense that it will not happen.

THE SHORELANDS

The geological complexity of British Isles coastlines is typified by multifarious islands vulnerable to the impact of the sea (e.g., Island Vulnerability, 2006; Lewis, 1979). Experience reflected in topographical naming of islands, actual or partial, present or ancient, is more numerous in the Thames Estuary and on the north Kent coast than on many other 100 kilometer stretches of coastline. Examples include the Isle of Dogs; Canvey Island; the Isle of Grain; the Isle of Sheppey, itself divided by Elmley Island and the Isle of Harty; and the Isle of Thanet.[2]

TABLE 1. Recorded sea-flood events: Thames Estuary south-shoreland and north Kent.

Date		Location	Description
1236		London	The Thames was reported as overflowing, "and in the great Palace of Westminster men did row with wherries in the midst of the hall" (Stow, 1580, quoted in Environment Agency, 2006).
1663	December	London	"There was last night the greatest tide that ever was remembered in England to have been in this River all Whitehall having been drowned" (Pepys, 1905, quoted in Environment Agency, 2006).
1703	November	S.E. England	"The Great Storm which devastated south-east England on November 26, 1703, tore down buildings, ripped off roofs, blew fish from rivers, sent clouds of salt spindrift 25 miles inland, flattened trees and steeples and at St. Peters in Thanet lifted a cow into the uppermost branches of a tree" (Faux, 1982).
1890s		Whitstable	"The great flood of the 1890s" (Whitstable, 2005).
1928	January	London	The city, Southwark, Lambeth, Westminster, and Hammersmith were affected when "... the embankment near Lambeth Bridge collapsed" and water flooded domestic basements so quickly "that people were unable to escape and 14 were drowned" (Meteorological Office, 2005).
1949	8 January	East Coast	(Steers, 1953:280)
1953	January/ February	East Coast	"From Tilbury to London's docklands, oil refineries, cement works, gas works and electricity generating stations were flooded ... 100 meters of sea wall collapsed, causing more than 1,000 houses to be inundated and 640,000 cubic meters of Thames water to flow into the streets of West Ham. The BP oil refinery on the Isle of Grain was flooded, as was the Naval Dockyard at Sheerness" (Meteorological Office, 2005). • The Isle of Sheppey was cut off by floods from mainland Kent. • Whitstable and Seasalter were severely flooded. • Sea flooding ocurred at Faversham on Nagden and Ham Marshes.
1976	January	East Coast	In terms of sea levels and the extent of damage, this year "ranks equally beside the 1953 Holland flood," but due to improved defenses and warnings, there were far fewer casualties (Munich Reinsurance Company, 1978).
1978/ 1979	January	Isle of Sheppey	"In 1978, the Island was cut off from the mainland by snow and floods, and again in 1979 by flooding" (Sheppey Access, 2003).
1987	October	S. England	Numerous small boats were wrecked or blown away. A ship capsized at Dover, and a Channel ferry was driven ashore near Folkestone. The storm killed 18 people in England and at least four more in France. The death toll might have been far greater had the storm struck in the daytime (Meteorological Office, 2005).

Marshlands are even more numerous than islands. Sometimes synonymous with them, and similarly isolated and inaccessible, their names mark an added hazardous significance to low-lying, unstable, treacherous, and largely unusable wilderness: Greenwich, Plumstead, Rainham, Cliffe, St. Mary's, Grain, and Luddenham Marshes, with Elmley and Harty Marshes taking their name from the Sheppey islands upon which they stand. There are many other examples.

SOME HISTORIES OF SEA FLOODING

As riverine inland flooding continues to attract attention by its departure from historical incidence (Meteorological Office, 2005), flooding by the sea continues to recur seasonally, in late autumn and in winter, as it has through history. The prognosis is that both sources of flooding will increase (GLA, 2005).

It would be unusual for any part of the U.K. coastline not to have a history of storms and floods, and the North Kent coast is no exception. From Foreness Point in the east, westwards to what is also the southern shore of the Thames Estuary as far as Woolwich on the edge of Greater London, recurrent sea flooding has been a normality that history has largely deemed not to record (see Table 1).

London has been at risk of flooding since its earliest days: a large city, intensively constructed on low-lying land on the shores of a large tidal river. Severe floods were recorded in 1236, 1663, and 1928, when parts of Lambeth were severely flooded and 14 people lost their lives. Elsewhere, Whitstable (2005) experienced "the great flood of the 1890s." Other storm surges caused damage in eastern England in 1976, 1978, and 2001, but the "East Coast Floods" of 1953 remain as the worst in living memory.

The 1953 "East Coast" Storm and Floods

During the night of January 31 to February 1, 1953, a severe storm with a three-meter sea surge almost coincident with a spring high tide, travelled down the east coasts of Scotland and England. Approximately 307 people were killed on land and at least 207 drowned at sea, U.K. £5 billion (1998 value) of damage was caused, more than 32,000 people were evacuated, 24,000 houses were damaged, and major transportation links were made impassable (Pollard, 1978:26).[3]

Several publications about the storm refer in their titles to the "East Coast Floods,"[4] by which its impact on the north coast of Kent may have been inadvertently disguised. The 50th anniversary in 2003 was a timely reminder with numerous newspaper articles, a television documentary, and website references, one by the Environment Agency (2006) showing the extent of the storm and affected areas.

There are many references to the effects of the floods in Kent, though titles do not reflect the fact. For example, Grieve (1959:178), along with photographs, records the following:

> *The tide in Kent rose in some places as high as eight feet (2.5 meters) above the predicted level. More than 78 square miles of low-lying ground were inundated. Industrial undertakings on Thames-side were put out of action. On the Isle of Grain, the British Petroleum Company's refinery was flooded. On the exposed north Kent coast, the promenades at Margate and Herne Bay, and the newly-constructed concrete sea wall at Minnis Bay were pounded and broken by waves. The 60-foot-high lighthouse at the end of the jetty at the entrance to Margate Harbour was undermined and fell into the sea. The Isle of Sheppey was cut off, half of it under deep water, and three-quarters of the town of Sheerness, including the Naval Dockyard, was flooded.*

Similar to Grieve (1959), Harland and Harland (1980:42) state the following:

> *On the Kent side of the Thames Estuary twenty-two thousand people were trapped by the flood waters and many cattle were drowned. At the Royal Naval Dockyard at Sheerness, a submarine sank, and a frigate capsized as water flooded their dry docks.*

Along with a map of inundated areas including Kent, Steers (1953:281, 289)[5] states the following:

> *On the south side of the Thames Estuary the winds were more directly on shore. There was considerable erosion in Sheppey and also in the soft cliffs at Beltinge just east of Herne Bay. The ruined church of Saint Mary at Reculver had been protected, but there was some erosion there. The low ground west of Whitstable was flooded, and huts and houses at Tankerton damaged. The low ground between Reculver and Birchington was flooded, and the main north Kent railway put out of action. Beyond the North Foreland there was far less damage, and although flooding occurred, the effects of the storm were of minor significance .... In the Thames ... inundations due to overtopping of walls and the formation of breaches took place.*

A map of flooded areas is shown in Summers (1978:86). The Environment Agency (2006) map shows the Thames Estuary south coastline and the Kentish north coast to have been affected. Extensive flooding is shown to have occurred on the Isle of Grain, along the River Medway, and on the Isle of Sheppey. Further eastward, 2,000 people were made temporarily homeless at Whitstable where the surge overtopped and broke sea defenses. At Herne Bay, the pier was destroyed, but shoreline defenses held. At Margate, defenses were overtopped, and 300 houses were flooded. In Deal, further south on the Kentish east coast, defenses were breached, and houses were flooded. The same map shows Canvey Island off the Essex coast, where sea defenses were overwhelmed, the whole island was under water, every house was evacuated, and 58 people lost their lives. The Thames Estuary significantly flooded both coastlines as far upriver as Rainham and Woolwich.

Areas of the coasts of Lincolnshire, Norfolk, and Suffolk also suffered severely and there were fewer reports from north Kent coastal areas than from Essex and northwards. This may be for two reasons. First, as Pollard quotes from the Waverley Report (Home Office, 1954),[6] as the storm moved southwards down the North Sea, the tide and surge were higher on the east coast of England than elsewhere but were partially deflected northward at the southern end, which caused the highest sea levels to be on the coast of Holland. Although the report also stated that a surge will travel up estuaries in the same way as does a tide, it is possible to envisage a situation during the 1953 storm where the south coast of the Estuary was protected as a result of deflection of the storm and surge, together with some additional protection for the Kentish North coastline afforded by its North Foreland against a counterclockwise storm motion when located in the southern end of the North Sea. Only one death was reported from the north Kent coast; however, some reports list none (Kelman, 2003).

The second reason is that although there was less development and habitation along all affected coasts in 1953 than there is now, on the North Kent coastal marsh and low lying lands on the Isle of Grain, the Isle of Sheppey,[7] and the shores of the River Medway and inlet of The Swale, there was comparatively little habitation on the coastal margins. Less habitation anywhere means fewer deaths, less damage, and lower risk.

To summarize, although sea defenses have been strengthened and raised since 1953, the threat of another major North Sea storm surge disaster has not been eliminated. The risk today has likely increased due to sea-level rise resulting from climate change, the age of sea defenses, extensive development in vulnerable areas, and a lack of awareness of flood vulnerability.

CLIMATE CHANGE

Climate change as defined by IPCC (1990) is likely to lead to increased storminess, heavier rainfall, and rising sea levels around the U.K. (e.g., GLA, 2005). Globally, sea levels are expected to rise by "around twenty-eight centimeters by the 2050s" (DEFRA, 2005) or up to a meter over the next 100 years. That is an anticipated average of up to one centimeter each year. In southeast England, where land is subsiding as well, sea levels in relation to land levels are already increasing and are estimated to rise by 41 centimeters by 2050 (DEFRA, 2005).

As the Environment Agency (2006) states, tide levels are steadily increasing due to a combination of factors including higher mean sea levels, greater storminess, increasing tide amplitude, the tilting of the British Isles to the southeast, and the continued settlement of London on its bed of clay. Seasonal high tides riding on an already higher mean sea level, and storm surges, possibly in conjunction with high tides, additionally conspire to seriously increase the incidence and severity of coastal flooding.

According to Steers (1953:280), storm surges are not uncommon, and significant surges are reported on England's east coast at the rate of at least several per century (Parker, 1978). Storm surges occur in conditions of low atmospheric pressure that cause the sea to rise and move as a "hump" with the depression. When this massive volume of water forms in the deeper northern part of the North Sea and reaches the shallower southern part, the surge becomes greatly increased. Strong winds can also exacerbate wave behavior and surge height. If a surge coincides with a high astronomical tide, conditions become more dangerous, especially if the surge enters the Thames Estuary creating a serious risk of flooding along its north and south banks. As DEFRA (2005) stated,

> *Some of the most noticeable impacts of climate change in the United Kingdom will come from sea level rise ... . The risk of coastal flooding will increase, endangering property in those areas and*

damaging natural habitats. The rate of sea level rise will vary across the United Kingdom, but will be most significant in south-east England where land is also subsiding.[8]

These are not newly discovered phenomena. Their increasing incidence was foretold by IPCC (1990). Islands internationally, of all kinds, shapes, sizes, origins, and levels, identified themselves in 1989 as first in line for the experience of the impact of sea-level rise (IPCC, 1990; Island Vulnerability, 2006; Lewis, 1989a, b, c; 1990a, b, c; 1999).

FLOOD DEFENSE AND FLOOD RISK

Since Samuel Pepys recorded six feet of water in Whitehall in 1663 (see Table 1), London has protected itself from flooding with 320 kilometers of sea walls, 240 floodgates, the Thames Barrier, and 17 smaller barriers (Leake, 2005). The 1953 floods led to the initiation of an improved coastal flood forecasting system, a more scientific approach to sea defenses, and the building of the Thames Barrier, although river walls and embankments had been strengthened and raised in 1897 and again after the floods of 1928. Legislation to proceed with the construction of a barrier was passed in 1972, and 80 kilometers of interim improvements to sea defenses between Putney and Purfleet, started earlier, were completed by the end of the same year.

During the mid-1970s, before the Thames Barrier then under construction had been completed, maps of central London were bill-posted (GLC, n.d./c. 1975), showing "the area at risk in certain weather conditions when a high tide between August and April could cause flooding." Extensive areas bordering the Thames and prone to flooding were shown in blue. Also shown were emergency terminals for surface and underground rail lines in the event of lines being closed. Public warnings would be given "about four hours before flooding seems likely," and sirens would sound in the areas at risk "about one hour before expected flooding." Under the subheading of "what you should do," people were instructed to "head for home as soon as you can" and "if you live in the (flood prone) area, stay tuned to the radio, listen for the sirens and be ready to follow advice given by your local council." No flooding was recorded, to the good of those who were vulnerable either to flooding or its political consequences.

The Thames Barrier was constructed between 1974 and 1982 and was first used in February 1983 (Environment Agency, 2006). With bank levels two meters higher, approximately 32 kilometers of flood defenses were constructed downstream of the Barrier, which included the six-meter-high additional barrier at Barking. Currently, further improvements to the Thames flood defenses are already under consideration as a component of an Estuary-wide flood risk management strategy (Lavery and Donovan, 2005).

New housing and other development, now being proposed for the London Thames Gateway, is in danger of creating new and intensive occupation of land known to be prone to flooding. To proceed with such development, either in ignorance or in disregard of consequent exacerbation of vulnerability to flooding, or in the assumption that there are, or will be, "flood defenses," would be a policy grossly lacking in awareness of the reality of flood hazards. Partly due to the feeling of being protected by the sea defenses, many of them aging, coastal development in England has been rapid. The number of people and the value of property highly vulnerable to a major storm surge event in eastern England is far greater now than in 1953. Flooding may occur with or without precedent, but flood risk does not exist until people occupy land vulnerable to flooding. As Gilbert White (1974:3) succinctly wrote 30 years ago, "Floods would not be hazards were not man tempted to occupy floodplains."

ADJUSTMENTS

Use of the term "adjustments" to hazards emanates from American flood research (e.g., White, 1974:3) and is appropriate for responses to a risk of which comprehension is adequate. Any large area designated for housing development, and especially one in a region with a history of flooding, creates the need and the opportunity for a comprehensive program of adjustments to take appropriate account of current and future risk. Proposals for London Thames Gateway and North Kent development require integral analyses of flood histories, while factoring in predicted increases in the incidence of storms, torrential rainfall, sea level rise, and implications for low-lying coastal land. The design of new housing, community development, and modification of existing dwellings has to be reconsidered for it to make its own contribution to sustainability.

Where to Build

Topographical analysis, for example, would provide a preliminary outline for more detailed land-use planning by identifying the lowest and the highest land and its extent and propensity to flooding. This elementary and fundamental requirement, a recommendation by the Association of British Insurers (ABI), reveals how in England, "planning" has not always fulfilled its primary function of defining on a regional scale *where* new building should, or should not, be permitted — as distinct from the debased process it has largely become, of approving or disapproving piecemeal proposals of *what* to build. As the ABI (2005:3) emphasize, "It is essential that the Government develops stronger and more strategic land-use planning policies." Similarly, Willis (2005) calls for a "vertical element" to flood mapping to show the depths to which flooding could occur. It is extraordinary that the initiation of a common sense basis for the planning of development for any area at risk from flooding appears not yet to have been activated.

The ABI (2004:15) propose sequential occupation of land in a way that precludes development liable to flood until higher and "protected" land is fully developed. It seems likely at present, however, that due to political pressure to achieve arbitrary housing targets, new construction will proceed at a pace in excess of that for new flood defense works.

Making communities sustainable by flood management is the subject of an ABI graphic comparison of areas benefiting from flood defenses (ABI, 2005:22-23). Thirty percent of new development sites of the Thames Gateway is on floodplains, the highest number of all development areas. Thus, Thames Gateway areas are said to benefit the most from flood defenses, but conversely, defense failure during a storm surge, including overtopping, would be more catastrophic there than elsewhere.

Flood Defense Options

After the storm of 1953, it was observed (Steers, 1953:292) that "where beaches and dunes are wide, damage may be small"; that "where the beach is steep, big waves break directly on it and override it and ... may form breaches"; and that "where there is a wide area of sand and salt marsh fronting the coast, little trouble occurred, since the sea spent some of its force well away from the coast." More than 50 years later, in the 2005 aftermath of Hurricane Katrina at New Orleans, a similar observation was recorded:

> *If you could cross the river from where we are now, you'd see that there are very few wetlands left. Where there are substantial wetlands across the river, the damage is much less catastrophic. We've always had hurricanes, it's just that we're much more vulnerable now to their impact because of the loss of wetlands.*
> (BBC News, 2005)

Flood defenses do not have to be walls of concrete, but when they are, they are better able to withstand the forces of water if there is an extent of beach or marsh in front of them. In his seminal book, McHarg (1971:7) advised against them altogether, comparing American sea defenses to those in Holland:

> *In their long dialogue with the sea, the Dutch have learned that it cannot be stopped but merely directed or tempered, and so they have always selected flexible construction. Their dikes are not made, as are our defences, with reinforced concrete. Rather they are constructed with layers of fascines — bundles of twigs (bundles of sticks used for engineering purposes) — laid on courses of sand and clay, the whole of which is then armored with masonry. The dunes, stabilized with grasses, provide even greater flexibility than dikes, accepting the waves but reducing their velocity and absorbing the muted forces. In contrast, concrete walls invite the full force of the waves and finally succumb to the undercutting of the insidious sea.*

Managed realignment, now an accepted strategy against sea-incursion (Pethick, 2002), is a land-use system more advantageous than structural attempts to halt the flow of a continually rising sea. Flatlands of the Estuary and north Kent could be designated similarly. Former or new wetlands, marshlands, and shingle beaches provide buffer zones against the incursion of rising seas, provide or retain wildlife sanctuary, and become welcome areas for recreation — with marine-built raised walkways over the mudflats. Storm surge would necessarily be resisted further inland by naturally or artificially raised higher ground with new building raised and set back. In many storm-surge-prone coastlines of the world, selected saltwater planting is known and practiced as a significant impediment to the flow of water and the erosion it causes. Appropriate grasses and sedges, for example, are not unknown in England and should be exploited for similar purpose (McHarg, 1971:10-17). The entire estuarine coastland belt could be landscaped as flood-impeding parkland.

A consensus has thus existed for at least 50 years that there are ways to resist the sea that are more preferable than concrete or masonry sea walls and that where sea walls are the only practical alternative, the walls are protected against overtopping and inland-side erosion of foundations that ensues. It does appear, therefore, that current lobbying for open space, parkland, and preservation of wetlands and wildlife habitats should beneficially be accommodated wherever feasible.

Maintenance, rarely adequately attended, is crucial to flood defense. The ABI assert that approximately five percent of tidal defenses in the London Thames Gateway are in poor condition and need urgent attention. There is no compiled information on the condition of an additional 65 percent of flood defenses (ABI, 2005:16). Earthen embankments are liable to erode due to crossings or use as footways (Holland denies public access onto its dunes; see McHarg, 1971:9) or from the flow of water. The foundations of masonry and concrete flood walls can become similarly eroded and exposed, and the effective life of most reinforced concrete structures may be curtailed in saline environments. Flood waters are rarely a slowly rising, benign, and placid phenomenon (e.g., Kelman and Spence, 2004). The power of forcefully flowing water is astonishingly destructive, especially to older construction of whatever purpose. A thousand liters of water has the force of one ton travelling at speed. Maintenance of height, as well as condition, of flood defenses of whatever kind of construction is crucial in current circumstances of incremental increase in sea level in relation to land levels.

What to Build

Little attention has yet been given to changes to the form and material of new-build housing for the achievement of increased resilience to flooding. On the contrary, innovative proposals have so far received more regulatory impediment than positive encouragement. Proposals to raise houses higher, on stilts for example, have been rejected due to previously established height restrictions or fears that stilted spaces would become occupied in the future. To build higher, on stilts or not, would seem to be obvious and has been permitted by some local planning authorities. There would seem to be little difference between houses with their primary floors raised above secondary uses at ground level, on the one hand, and houses raised on a stilted area that might be given a secondary use in the future.

In the face of massive demands for new housing and extreme environmental threat, the design of dwellings has to be allowed to change if flood risk is to be taken seriously. Guidance must come with consistency and logical explanation if it is not to be ignored by authorities and the public. Raising the ground floor above the likely flood level, restricting the ground-floor space to flood-compatible uses, such as car parking, and the building of "higher density apartment blocks to lift homes out of the floodplain" (ABI, 2005:8, 30) are sound words, but they are also policies not yet in general favor with the Environment Agency, with the planning system, nor perhaps, with a public not fully aware of flood risk.

Floating and amphibious houses are ready to move beyond experimental stages, with the Netherlands currently constructing a floating residential district. Raising primary floor levels has the advantage of an obvious pragmatism, one to be found on inhabited coastlines worldwide, from the Gulf of Mexico to the Bay of Bengal (e.g., FEMA, 1986; United Nations, 2004), where dwellings and other buildings in areas of flood risk are invariably raised above ground levels and, where possible, above anticipated flood levels. Ground-level spaces may be used for a car, a bicycle, or a boat — not a luxury in known flood-risk areas.

There are few examples in England of houses designed to be resistant to sea flooding: a private house on the Essex coast at St Lawrence[9] and a housing development at the Gravesend Canal Basin in Kent[10] (Young and Kucharek, 2005:76-78). Their descriptions illustrate the struggle of working within a regime of conflict and contradiction between authorities currently involved in the "planning" process, as being as great as the struggle against the water itself. Nevertheless, other proposals, for making kitchen units of plastic instead of chipboard for example, must soon come to be superseded by innovation of a more imaginative and fundamental kind, especially which considers the full life cycle and energy costs of different proposals.

A useful research program would relate already existing material on the nature of flooding and its prevention and abatement with revisions in building design, construction, and community development required for living with flooding, safety, resilience, and recovery. Such a program would combine inputs from, for example, geographers, hydrologists, planners, and architects. Meanwhile, projects for developments in the London Thames Gateway have commenced.

THE LONDON THAMES GATEWAY

The London Thames Gateway is described as the largest regeneration site in the world:

> *Large parts of London Thames Gateway [are] a messy montage of polluted industrial wastelands, relic wilderness and mediocre new residential development in some of the most socially deprived boroughs in the EU. The city here is a series of fragments, surrounded by semi-inhabited or deserted backlands, concrete viaducts, vast hellishly noisy roads, and abandoned strips of unusable territory in which a wild unkempt nature has been taking over again.*
> (Muirhead, 2005:88)

A diagrammatic map accompanies Muirhead's (2005) article, showing where development studies have already been commissioned and identifying nine specific projects[11] at the planning stage. The map focuses on street patterns as well as movement and communication by pedestrians and traffic, and it envisions mixed domestic and commercial developments for which massive road and rail intersections are already under construction.

The article claims the projects will "lift discussion to a higher level than the mainstream" (Muirhead, 2005:88). Identification of each area's "historically sedimented characteristics," such as the discovery of the origin of the name "Erith," meaning "a gravelly place," and using these as design features is far from such metaphors for water and wetland serving as hints of concern for flood risk, of which there is no mention. Only three of the sites being studied are within the area protected by the Thames Barrier, which is not shown on the accompanying map. Flooding, at this stage of operations, appears not to be considered as an influence upon planning and design of an area as large as Manchester.

An accompanying article (Richardson, 2005:5) usefully appeals for some retention in planning and design of the present quality of flatland landscape: "It could be a modern day Venice, a city built in the most inhospitable muddy terrain," but she appropriately cautions, "the rush to parcel up the best plots of land along the river and sell them to housing developers has scuppered hopes of creating an overall vision for the area, or for using the river for anything other than the odd leisure pursuit." The river receives mention as a scenic element in flatland landscape. There is no mention of the river as hazard. Indeed, land along the river edge offers the preferred and, no doubt, most costly sites. "This is hardly the stuff of dreams" Richardson (*ibid.*) says of objectives expressed by the Office of the Deputy Prime Minister. It is not. It is the stuff of nightmares. St. Mark's Square in Venice usually floods several times a month (Fletcher and Spencer, 2005).

In contrast, a recent *Regeneration and Renewal* supplement devoted entirely to the London Thames Gateway carries an article drawing attention to the risk of a "housing at all costs" policy where flood risk will be given only "cursory treatment" (Willis, 2005:14). The article quotes a report by the London Assembly Environment Scrutiny Committee as being critical of the "plethora of organizations producing strategies and policies" (*ibid.*:15) and blames institutional fragmentation for the absence of an integrated approach to dealing with the issue of flooding.

RISK-ECOLOGY AWARENESS

It is not difficult to attract people to occupy hazardous floodplains, as they do, or to live close to the sea. The difficulty is to keep people away. The U.K.'s varied shoreline is lined and littered with traditional, modern, old, new, domestic, and other development. Houses are either similar to those comprising English suburban housing developments everywhere or are typical of coastal, wood-built bungalows that were popular during the 1920s and 1930s when access to the sea from industrial cities was a novel experience. Little is different from houses anywhere else. Thousands of people live in similarly placed dwellings, compelled, regardless of risk, by deep desires for freedom and space. The making of positive "adjustments" to hazard is not their priority. Evidence of perception of risk is nonexistent.

Thousands more people are compelled for economic reasons or for the convenience of relocating for work or school. From among these, Bennett and Morris (2006:10) identified "a number of significant risks" that could undermine the creation of sustainable communities in the Thames Gateway. Flooding is not one of them. Tensions between new and existing populations and failure to attract "the sorts of home buyers needed to produce genuinely mixed communities" (*ibid.*) are issues of higher profile than environmental hazards. Only one couple interviewed is quoted as referring to flood risk: "You'll need a periscope to see out of your window" (*ibid.*).

Communities already at risk from sea flooding appear to not know their current or future risk. It is one thing to live with flooding and know the risk, but it is quite another to live with flooding in ignorance of that risk. The act of building new speculative housing on land at risk from flooding, especially as part of a housing program initiated by the government, will imply a stability and safety that may not exist. While legislation exists to protect buyers from unscrupulous sellers of food, clothes, furniture, and cars, it does not protect buyers of newly built houses on floodplains. These buyers are to be induced into areas at risk of flooding without knowledge of that fact.

Steers (1953:293) has stated the following:

> *It is ... right to say that the nation acting through its central and local government authorities is in a sense responsible, because if houses and towns are built close behind sea walls and at levels which mean that they could be flooded at any high, or even ordinary, spring tide, those houses are in a potentially dangerous position. Conditions like those existing on January 31 are fortunately rare, but they can and doubtless will recur.*

A progressive, comprehensive, and coast-wide program of sea-flood risk awareness should be made a priority requirement for providing the public with information, guidance, and advice. Financial assistance to make existing coastal dwellings more flood-resistant and more resilient in recovery (e.g., Crichton, 2005) should be made available to owners of dwellings exposed to increasing risk. The same kind of information that is available on inland river flooding is required, together with additional information about windstorms, storm surges, forcefully flowing saltwater, and other hazards.

House design should visually demonstrate and convey the reality of increasing sea-flood risk. In other words, measures should be taken to expose sea-flood risk, and the public should see evidence that house design and construction has been altered in response to that risk. Only then would public choice be made out of awareness, not out of ignorance.

Housing significantly raised above ground levels would be the most obvious message carrier. A consequent flood-resistant comprehensivity of natural habitats, hazards awareness, and human-made habitation is more likely to influence the public than the plethora of agencies and organizations[12] currently serving only as impotent symbols of the message.

NOTES

1. In November 2005, a "flood defense scheme" costing £4 million at Ottery St Mary, Devon, was reported to have failed twice in two weeks causing serious domestic and commercial flooding (Morris, 2005). Further examples and discussion on this issue are in Etkin (1999), Fordham (1999), and Kelman (2001).

2. The Isle of Thanet, in the northeast corner of Kent, is bounded by the North Sea and by the rivers Stour and Wantsum. Thanet was an island until the 16th century and includes the coastal towns of Broadstairs, Margate, and Ramsgate. Traditionally known for growing cereal, it has become a major area for the cultivation of vegetables. In addition to agriculture, industries include toymaking, signmaking, and plastics.

3. The storm had an even greater impact in Holland where there were "nearly 1,800 deaths, loss of some 50,000 head of cattle and 10,000 hens 'when more than fifty dykes burst almost simultaneously and nearly half a million acres of polder country were swallowed by a raging sea'" (Pollard, 1978:69, 118).

4. For example, see Hilda Grieve's *The Great Tide: The Story of the 1953 Flood Disaster in Essex*, Harland and Harland's *The Flooding of Eastern England*, Michael Pollard's *North Sea Surge: The Story of the East Coast Floods of 1953*, and Dorothy Summers' *The East Coast Floods*.

5. J.A. Steers was a professor in the Department of Geography, University of Cambridge, and a member of the Waverley Committee.

6. The chairman of the Waverley Committee, Lord Waverley, may have been better known as John Anderson, who also gave his name to Anderson War Shelters. Anderson air-raid shelters for home erection, internally or externally, were issued free to low-income earners and sold for £7.00 to others (Air Raid Shelters, 2002) and were an early example of government participation in domestic protection against hazards.

7. The Isle of Sheppey, 80 kilometers southeast of London and 80 square kilometers in area, is separated from mainland Kent by The Swale, an inlet varying from one-and-a-half kilometers to less than half a kilometer in width. Approximately 15 kilometers long and eight kilometers at its widest, the Isle is divided longitudinally and roughly equally into low-lying marshland to the south and higher ground to the north reaching 60 meters. This higher ground is the reason for habitation and development to have traditionally taken place on the estuary shoreline as evidenced by Queenborough, Sheerness, Minster, and the villages of Eastchurch, Leysdown, and Warden.

Thirty-six thousand people currently live on the island, which was linked to the mainland by Kingsferry until 1960 when the construction of a lift-bridge for rail and road traffic was completed. The lift-bridge allowed large shipping to pass but impeded other traffic. A new road bridge is currently under construction that will encourage further development of the island.

A naval dockyard once at the west end of the island is now a deepwater commercial port, and pharmaceutical and steel industries have developed. Current low land costs, good infrastructure, and greatly improved transportation make Sheppey an obvious place for future habitation and development.

Coastal defenses ordered by King Richard II were built on the island between 1377 and 1399, most likely against flooding. The 1953 floods caused much damage on the island; the seawall had to be rebuilt at Cheyne Rock (Sheerness) and heightened along its length of three and a half kilometers. The Island was cut off from the mainland by snow and floods in 1978 and again in 1979 by flooding (Sheppey Access, 2003).

8. Steers (1953:291, quoting Valentin) states that in the region of the Thames approaches, subsidence is "of the order of 1-2 millimeters a year, which is equivalent to a foot (300 mm) in 150-300 years. This is a significant amount, and throughout a long period of time has made itself felt in various ways. The Thames is now tidal to Teddington; in Roman times it was probably unaffected by tidal influences above London Bridge. The change of level since Roman times may amount to 15 feet (4.5m) … ." An additional 50 years or 50-100 millimeters should now be added to these figures.

9. Alison Brooks Architects.

10. Kiran Curtis Architects.

11. At Shadwell, Bow Church, Sugar House Lane, Lower Lea Valley, Roding Valley at Ilford, East Beckton, Plumstead Southern Ridge, Erith, and the Royal Victoria Dock.

12. The Association of British Insurers; Department for the Environment, Food and Rural Affairs; East London Urban Development Corporation; English Partnerships; Environment Agency; Greater London Authority; Kent Thames-side; London Assembly Environment Committee; London Development Agency; London Thames Gateway Partnership Board; Office of the Deputy Prime Minister; Thames Estuary Partnership; Thames Gateway Forum; Thames Gateway Kent; Thames Gateway London Partnership; Thames Gateway Strategic Partnership; and other subregional development agencies, local councils, and non-governmental organizations.

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Ilan Kelman's main research and advocacy work relates to two areas: disaster diplomacy, how disasters do and do not bring together enemy states; and island vulnerability, building safe and healthy communities on small islands and other isolated areas. Other topics of interest are how and why people die in disasters, ensuring safe schools worldwide, and improving refugee settlements and shelter. Ilan's Masters dissertation was on managing volcanic eruptions on small islands, and his Ph.D. dissertation was on building collapse during floods in England. He has lived and worked in Barbados, Canada, Ireland, New Zealand, the U.K., and the U.S. More details are available at http://www.ilankelman.org. He is also a researcher at the Center for Capacity Building and National Center for Atmospheric Research, which is funded by the National Science Foundation.

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